DOCUMENT RESUME

ED 188 889 SE 031 134

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TITLE Metric Education: Lead the Way Today or Follow the Crowd Tomorrow.
PUB DATE Apr 80
NOTE 8p.; Paper presented at the Conference for the National Association of Elementary School Principals (Miami Beach, FL, April 20, 1980).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Decimal Fractions; Elementary Education; *Elementary School Mathematics; *Fractions; Mathematics Curriculum; *Mathematics Education; *Mathematics Instruction; *Measurement
IDENTIFIERS *Exponents (Mathematics)

ABSTRACT

This presentation advocates furthering the meaningful educational use of the metric system. Included is the suggestion that a combination of metric use with exponents could replace much more cumbersome calculations with fractions in the English System. Comments from articles on fractions are included to support the point that children have difficulty with fractions. Ways in which individuals can support "going metric" are also listed. (MP)

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METRIC EDUCATION: Lead the Way Today or Follow the Crowd Tomorrow

As presented at the 1980 National Association of Elementary School Principals' conference at Miami Beach, Florida, Sunday, April 20th

by

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Good morning! Thank you for attending my session. I hope it is one that proves to be worthwhile to you and I hope you find it to be one of the best at the Miami conference.

In making my presentation, I have a number of objectives in mind. They are as follows:

1. To give you a general picture of what the metric movement looks like today.

2. What to look for in a quality metric publication.

3. What I believe is the most outstanding reason why educators should be going metric in the classroom and, subsequently, the curriculum changes that are imminent when the metric system becomes our sole system of measurement. In regard to this, I plan to cite some examples from selected readings.

4. What you can do upon your return to your school system to act as a catalyst in the metric movement.

The metric system is here. In the March 15th, 1980 Metric Board news release, it is stated that General Motors found that by phasing in conversion on a gradual basis, the actual cost of converting to metric has been less than 1% of the original estimate.

In a recent Metric Association Newsletter, it was stated that gasoline sales were moving rapidly to a metric basis. In another U. S. Metric Association Newsletter, it stated that the governor of the State of Kansas, John Carlin, supports metric education. He said, "I have learned that Americans will have to learn the metric system to trade with the Chinese. They don't like our measurement system and aren't about to learn it."

From Dimensions, a National Bureau of Standards publication - "Metric has come to many sectors of American life over the past several years at an ever accelerating but erratic pace. Industry continues to lead the way in the private sector. At least 37 major corporations have announced policies to convert their operations - Caterpillar Tractor, Ford Motor Co., General Motors, Xerox Corporation, 3M Corp., to name a few.

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Pharmacists have always used metric. Weather reports are given in both English standards and the metric system of measurement. Nearly all of the canned goods, cereal boxes, and other foods found on grocery shelves are labeled in metric units of measure. All liquor is bottled in metric-sized containers.

From Dimensions, another quote - "Another sector of American life that has seen growing use of the metric system is education. School systems are specifying the use of metric as the primary measurement language in new textbook purchases."

I personally find this hard to believe, especially when one considers the small amount devoted to the teaching of the metric system in a basic elementary classroom text. The few pages devoted to metric instruction accounts for incidental learning experiences, and from incidental learning we learn little, if anything.

Teaching materials are fundamental to the process of metric conversion. According to "Going Metric", a National Institute of Education pamphlet, "The early, intense demand for metric materials results in a flood of inaccurate and inadequate materials."

How true this is! This is exactly where educators are finding themselves today in education. The market is flooded with supplementary materials that are atrocious. One publication is a carbon copy of another. The publications tend to demote metric rather than promote it. The publications tend to confuse rather than to clarify. This predicament is directly attributable to authors who do not understand the needs of children and teachers, and from lack of knowledge of how to teach metric in the classroom. In short, they are in need of classroom experience.

What do you look for in a metric publication that represents quality?

1.) a publication that offers teachers a basic understanding of the metric system.

2.) one that makes children and teachers aware that the metric system is a system of measurement that is based on units and subunits of ten. How is this accomplished? - By teaching all of the units of measure, milli through kilo. Don't bypass any of the units. When we teach reading we don't omit some vowels and consonants. For total understanding all letters and sounds are taught. Likewise, all prefixes (milli through kilo) and their meanings must be taught.

3.) a publication that offers teachers a successful sequence of instruction.

4.) one that relates the metric prefixes to their decimal counterparts through meaningful activities.

5.) a publication that utilizes the three domains of learning - cognitive, affective, and psychomotor.

6.) one that lends itself to inservice programs in which teachers can learn metric through the same series of activities they can subsequently use in their classrooms.

7.) a publication that is economical.

8.) one that relates metric measure to decimals and exponents and ties in all three with place value.

9.) a publication that is well-organized and thorough.

10.) one that treats metric separately with no reference made to the English system of measurement.

What is the most outstanding reason why we should be teaching the metric system of measurement and what are the implications? In our schools we should be "getting off" the teaching of the basic operations with fractions and the English system of measurement, and we should be "getting on" with the teaching of the metric system. This sounds a bit far out, you say? Perhaps. But, if you give careful consideration to the curriculum changes that are imminent, the change is not at all that drastic. Rather, it is one that necessitates action.

You have the ability to change fractions to simplest form, eh? Bully for you! You can identify proper and improper fractions, huh? Great! You can find common denominators, change mixed numbers to improper fractions, and vice versa, right? Very good! And you have the ability to add, subtract, multiply, and divide fractions, correct? Bravo! But WHO REALLY CARES? Do you ever have the opportunity in your daily dealings, other than teaching children in the classroom, to perform the basic operations, or the other concepts associated with fractions? If you drew a blank as I did, or if you had trouble recalling the last time you performed any of the basic operations, I think you will agree with me this subject area should not be included in the curriculum.

There must be some reason, or reasons, for the inclusion of the teaching of the basic operations with fractions in the curriculum. One certainly is tradition. Thank you John Quincy Adams and other very special people who comprise a select finite set. Another could be traced to our English system of measurement. Thank you again John Quincy Adams and others. Because of the English system's makeup, we are forced into knowing something about fractions; i.e., halves, fourths, eighths, sixteenths, etc. Knowledge of equivalence is a must, but it is not a necessity for us to learn how to add, subtract, multiply, or divide fractions. So again, why teach the basic operations?

Some time ago I conducted a survey in which people from various walks of life were asked two questions: When was the last time you measured something? When was the last time you had the opportunity to either add, subtract, multiply, or divide fractions? Each person responded immediately to the first question without hesitation. To the second question the responses came very slowly or not at all. Those who admitted to having performed the basic operations with fractions did so in isolated incidents, infrequently, or not at all. Those who admitted to having operated with fractions could not recall having used all of the operations.

In the past, metric, decimals, and exponents were each taught separately. When I was in grade school I learned how to deal with decimals. In science classes in high school I was made aware of the metric system, but dealt little with it. Little effort was put forth by my instructors to teach my classmates or me about it. I had no real understanding of the metric system and, in fact, if my memory serves me correctly, I thought of the system as being somewhat of a nuisance. Exponents, too, were taught separately. I suspect your background will bear a strong resemblance to mine.

If, as educators, we would really get into the teaching of the metric system in our schools, we could make place value so much more meaningful. Metric units of measure could be related to their decimal counterparts and to exponents - with all three eventually being "tied-in" with place value. I'll cite one example to illustrate the importance of the above.

Let us assume a used pencil measures 7 cm. The prefix "centi" means hundredth. Therefore, the pencil measures seven hundredth meter. 10^{-2} also means hundredth. Therefore, 7.0×10^{-2} m in scientific notation is another way of expressing the length of the pencil.

meter	deci	centi	milli
ones	tenth	hundredth	thousandth
10^0	10^{-1}	10^{-2}	10^{-3}
		7	

I decided to conduct another survey of sorts myself. After having collected all of the past issues of The Arithmetic Teacher I had on hand, I perused each for articles that dealt with fractions. I also found some other sources with written materials relevant to the topic. There were fun types of activities aimed to take the pain out of learning various concepts, articles that alluded to problems children had with fractions, and writings that offered advice for teachers to help children master certain concepts. I hope you find my findings and thoughts to be of interest and significance.

From The Arithmetic Teacher, Ness, Jr. (1973), in his article entitled "Another Look at Fractions", straightforwardly admits children have problems with fractions. His opening statement is: "Students at all levels - in elementary and high school classes - have difficulty with fractions. There is considerable confusion in the minds of students when they have to operate with fractions." He then proceeds to outline algorithms with implications for elementary schools. The algorithms were sound, but my opinion is that the solutions presented did not necessarily make the operations with fractions any less difficult.

Bell and Rucker (1974), The Arithmatic Teacher, in their article, "An Algorithm for reducing fractions", discuss a problem with fractions and a way of coping with the problem. "In the teaching of elementary mathematics, one of the areas that seems to give the most trouble is that of the reduction of fractions." They then proceed to outline an algorithm that calls for a relatively good understanding of mathematics. In closing, the authors say the algorithm described has its shortcomings and that certain types of fractions may be more easily handled by another method.

Zweng (1973), The Arithmetic Teacher, "The fourth operation is not fundamental - fractional numbers and problem solving", approaches my overall philosophy. She says, "This, then is a plea to stop wasting teacher time and student time with division of fractional numbers."

From The Arithmetic Teacher, Wassmansdorf (1974) recommends the making of a fraction machine and operating it to help children reduce fractions. The fraction machine is a novel and innovative way to help children who have problems reducing fractions. The author states that "Reducing a fraction or finding a fraction equal to a given fraction can be quite a task for the slow learner. By the time he lists all of the factors of the numerator and all of the factors of the denominator, so much time has elapsed that the student is quite often tired and frustrated."

In the section "Using Research in Teaching", from The Arithmetic Teacher (1976), Carpenter, Coburn, Reys, and Wilson put their thoughts together in the article entitled "Notes from National Assessment: addition and multiplication with fractions".

All of the authors, researchers, etc, readily admitted that children in our schools have problems with the operations with fractions. Many suggestions were offered to help alleviate these problems, ie., introduce some topics earlier, approach problems differently, wait until the children are older before teaching the various concepts using concrete objects and then develop algorithms paced so as to firmly connect with the main ideas in the initial development, de-emphasize reduction of fractions to lowest terms until later in the program,, etc.

In Carpenter, Coburn, Reys, and Wilson's opening comments, they state that "development of computational skills with fractions has long been a part of the upper elementary and junior high school mathematics program. Current movements toward metrication have led some individuals to suggest that decimals will receive more attention in the mathematics curriculum with a corresponding de-emphasis on fractions. The suggestion may find an increased number of supporters, as recurring evidence indicates that pupil performance with fractions is discouragingly low."

These sentences make it obvious that with increased involvement in metric, fractions need not be taught. Clearly, the advantages are many, of which I will list only a few. Not only will decimals receive more attention, other areas of mathematics will be given more emphasis- problem solving, measurement, instruction using calculators, etc.

There is much evidence that supports the fact that pupil performance with fractions is low. Other than their having difficulty learning various concepts, the operations, etc., there must be a reason far more reaching for problems with fractions to consistently come to the fore. I believe the obvious is overlooked. Children who have difficulty learning about fractions soon forget what little they do know because they do not have the opportunity to work with fractions. Other children are affected, too, but in varying degrees.

Furthermore, Carpenter, Reys, etc. state that "Competency with fractions is important to many educational and vocational goals."

Why? If we very seldom, if ever, work with operations with fractions, they cannot be too important.

They continue - "Certainly not every citizen is required to add or multiply fractions."

Absolutely correct! A small minority do work with the basic operations of fractions and the only reason they do is directly attributable to our using the English system of measurement.

"Adult usage is, however, only one criterion for the determination of curriculum goals."

Definitely! And that's a very important criterion! As educators we are preparing our children for the outside world as adults. We most assuredly should not be preparing them for something in the outside world they are not going to need ---- as we have for so many years.

The metric system fits into the American mold of life. We use decimals on a daily basis. Our monetary system is decimal based. Calculators are decimal oriented. All film can be purchased in various millimeter units of measure. Weather results are broadcast in metric units, etc. Thus, in that metric measure is decimal measure, we, knowingly or unknowingly, use metric measure daily.

Children should know the basic concept of fraction - one-half, one-third, one-eighth,etc., but they do not need to know how to add, subtract, multiply, or divide fractions. With the elimination of the teaching of the operations involving fractions and the deletion of the teaching of the English system of measurement from the curriculum, we can spend our time more wisely stressing other areas in mathematics that will enable us to offer children a far superior mathematical program.

As educators, no matter what level - elementary through college - I feel it is our responsibility to "carry the torch" for the metric changeover. If it is to become a reality, we must do more than shake our heads in agreement with the thoughts I have expressed to you.

You can help at the local level by:

a.) going metric yourself in the classroom;

b.) encouraging other faculty members to go metric;

c.) talking to other administrators and imploring them to implement the changeover to the metric system;

d.) contacting school board members and persuading them to create a policy that will eliminate the teaching of the English system of measurement from the curriculum, and one that will mandate the teaching of the metric system;

e.) writing articles that express similar views as this one for your local newspaper;

f.) talking to parents in your community in an attempt to educate them metrically;

g.) discussing with sales representatives from large textbook companies the importance of the deletion of fractions in basic texts at the elementary level (They can pass on this information to authors of elementary texts);

h.) urging state educators and legislators to ignite the metric movement in education; and

i.) writing to your Congressman to mandate metric at the national level.

In closing, I would like to thank you once again for attending my session. I hope you enjoyed it, learned something, and I hope you found it to be worthwhile. Upon your return to your school system, I hope you are motivated to do something to promote metric.

Before closing, I do have one other objective in mind. I have written and developed some metric materials for children and teachers. For information regarding these materials, please write to

Pauper Press,
Box 303
Two Rivers, Wisconsin 54241.

It is not my intent to make my presentation a highly commercial one, and that is all I plan to say about the works I have written and developed.

The session is now open to questions. I'll do my best to answer them. If any of you would like to talk to me after this segment of the program, I will be happy to talk to you personally, and ---- by all means ---- Let us lead the way today in metric education and not follow the crowd tomorrow.

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